United States
Department of
Agriculture

Rural
Electrification
Administration

REA Bulletin
Number
61-16

Guide for Economic Evaluation of Distribution Transformers

FOREWORD

Since the oil crisis of 1974, there has been a steady escalation of fuel prices not just for oil, but also for gas, coal and nuclear fuels. The rising fuel prices have resulted in steadily escalating costs for electricity that have prompted the electrical industry to look for ways of reducing costs. One way is to reduce system losses as much as possible. A very effective method to reduce distribution system losses is to evaluate transformer losses and consider the costs in your purchase decisions. Lower loss transformers may cost more initially but the cumulative effect of the reduction of losses in many individual transformers can result in a significant reduction in system energy losses for which no revenue is received and, therefore, in the total cost of system kilowatt hours. Other significant savings can be in the reduction in magnitude of the system peak, with a resultant savings in the demand cost for kilowatt generating capacity.

Since there is now an acute awareness of the possible savings to be made by evaluating and buying the most economical transformers, the "Guide for Economic Evaluation of Distribution Transformers" (The Guide), has been issued to provide a quick and easy way to make economic comparisons of manufacturers' transformers.

The Guide gives three different methods. However, the second method, which utilizes calculation sheets and tables, is recommended because it is routine, can be done fairly quickly and is sufficiently accurate for comparison purposes. To do transformer evaluations, there is a great deal of system data required, which may not be available or is difficult to obtain. Every reasonable effort should be made to obtain data which applies specifically to your system. It is essential to do a meaningful transformer evaluation. However, there is a table, included in the guideline, of data obtained by Edison Electric Institute, that gives the range of system data for utilities all across the country. The data in the table should not be used except as a last resort.

By using this guide and your system data, you can obtain transformers which will be economical for your system. To ensure that you obtain transformers with losses equal to, or less than what you are paying for, incoming transformers should either be tested periodically for losses, or the manufacturer should be told to supply factory core and copper loss test data for each transformer supplied.

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AUG 1983
Date

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For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

REA BULLETIN 61-16

SUBJECT: Guide for Economic Evaluation of Distribution Transformers

I. Purpose:

The purpose of this bulletin is to provide the information and methods necessary to make consistent, meaningful present worth dollar analyses of the costs of owning transformers during their useful life.

II. General:

Present worth dollar analyses make it possible to compare the various manufacturers and their transformer design choices on an equal basis and thus determine which transformers have the lowest total owning cost on an REA borrower's system.

Transformer evaluations are important because transformers are one of the major components of a distribution system, and the cost of buying them comprises a large part of an annual equipment budget.

Although the first cost of buying transformers is great, other factors also contribute to their total cost. Among the factors are the costs of installation and removal, maintenance, taxes and interest. Generally these items are fairly inflexible (such as maintenance) or cannot be controlled by the borrower.

What can be controlled to a certain extent are the core and copper losses, which are a significant part of transformer operating costs. To get reduced core and copper losses, generally, means a more expensive transformer must be purchased. The change in transformer purchasing price, of course, affects taxes and the amount of money which must be earned to pay for the transformer.

It is not intended that the transformer with the lowest losses should be selected for use. The reason for an economic evaluation is to select a transformer which will provide the lowest total owning cost. Since the total owning cost includes both the price and the cost of losses, the evaluation will indicate the most economical transformer which will generally have neither the lowest price nor the lowest losses.

Also, as the cost of energy increases, the cost of losses becomes more significant, further justifying the time and effort necessary to do an economic evaluation.

III. ORGANIZATION

The guide is in four main parts. Part I defines and explains the terms used in the guide, presents mathematical equations, and explains their various components. A mathematical example shows how transformer costs are computed using the equations.

Part II contains forms titled "Distribution Transformer Loss Evaluation" which list the necessary information required to make an evaluation and show the step-by-step procedure to complete an evaluation. In conjunction with the "Loss Evaluation" sheets a family of tables is provided of escalation factors for inflation and factors for assumed transformer load growth. By interpolation, it is possible to derive from the tables factors for almost any inflation or growth rate, making many of the calculations in Part I unnecessary.

Part III describes a detailed "present worth" evaluation method which is more precise and gives more accurate comparisons. It involves year-by-year computations, using present worth values, to determine lifetime levellized costs. However, the additional accuracy does not usually warrant the time required.

Part IV outlines decisions which must be made and actions which should be taken to make an evaluation meaningful.

PART I

A. Basic Evaluation Formula and Calculation of Levellized Annual Cost

The basic evaluation formula utilizes the method of annual fixed charges and levellized annual cost of losses for the lifetime of a transformer, which has generally been agreed upon as the industry standard for computing lifetime operating costs. The formula for determining the annual owning cost is written as follows:

(a) fixed charges = FC (BP)

(b) excitation loss cost = $\frac{\text{Watts}_{NL}}{1000}$ (SC + 8760 (EC))

(c) load loss cost = $\frac{\text{Watts}_{LL}}{1000}\left[(PL)^2 (SC)(RF) + 8760(LF)(EC)\right]$

The terms used in the above equations are generally those for an electric system and the data obtained would be applicable to all transformers on a system. However, in specific cases, such as transformers for irrigation systems, the hours of usage or the load factor will be different. The results obtained will apply to that application only. The data used in the following calculations are general and the results apply to all distribution transformers as a group, used in an electric system.

1. Definition of terms

(a) - Levellized annual fixed charge rate

The annual revenue required to recoup the original investment, pay the average interest on the investment and pay related taxes during the life of the transformer.

BP - bid price is the unit price at which a particular transformer manufacturer offers to sell transformers.

(b) Watts_{NL} - the no load power loss in watts (core loss) of a transformer at rated voltage and 85° C.

SC - the demand charge in dollars per kW-Yr. For power systems that generate, transmit and distribute power, it is the annual cost of system capacity to supply one kW of power at peak load from the generator, through the transmission and distribution systems to the transformer. For systems that purchase power and distribute it, the annual value for SC is the monthly demand charge including escalation, multiplied by 12 to give $/kW-Yr.

EC - energy cost is the levellized cost, in dollars per kWh, to produce energy during the life of the transformer, including escalation, estimated inflation, and other factors which affect energy cost.

(c) $\underline{\text{Watts}_{LL}}$ the load loss at full load due to copper loss only

PL - The uniform equivalent annual peak load on a transformer during the period of the evaluation. It is an approximation of actual transformer annual peak load since it assumes that the annual peak load increases at a constant percentage rate.

RF - peak loss responsibility factor takes into account the fact that the peak load on a transformer does not usually occur at the same time as the system peak. The transformer contribution to the system peak load is usually only a fraction of the load on the transformer at its peak load, so RF is generally less than one (1).

LF - the loss factor of a transformer is the ratio of the average annual load loss to the peak value of the load loss. If the system (or individual transformer) capacity factor is known, the loss factor can be calculated for the system transformers or the individual transformer (see Appendix B).

Attachments at the back of this guide give information on how several items in the equations can be determined. If the necessary information is not available for your particular system, representative figures in Table I can be used for rough estimates. They are taken from a nationwide survey conducted by Edison Electric Institute in 1978 and are representative only. Actual figures vary considerably from one utility to another. Even though it may take considerable time and effort to determine such items as demand charges and energy cost, they should be determined for your particular system for a transformer evaluation to be meaningful.

2. Determination of Transformer Levellized Annual Cost

The data used in the following example are "typical" values. Several are taken from Table I.

FC = .18 (from Table I)

BP = \$380 (estimated cost of 5 kVA 7200 Volt single-phase transformer. In an evaluation the actual bid price of a manufacturer would be used.)

Watts_{NL} = 40 for manufacturer's 5 kVA transformer.

Watts_{LL} = 100 for manufacturer's 5 kVA transformer.

SC_I = \$91/kW-Year (The initial cost of system capacity from Table I.)

EC_I = The initial energy cost.

EC = to be calculated.

PL_I = Peak load initial.

PL = to be calculated.

RF = .55 (from Table I) (see Appendix A for method of calculation.)

LF = to be calculated (see Appendix B for method of calculation.)

Since the levellized annual cost method is being used, both the load and the energy costs must be levellized for the life of the transformer. The demand charge may also be subject to escalation and should be levellized if there is escalation.

Levelling means that a constant annual figure is determined for all the years that a transformer will be used. Using energy as the example, with energy costs rising, the levellized energy charge is higher than the initial energy cost and lower than the final energy cost. It is not an average! Levellized energy cost is determined by adding energy costs on a year-by-year basis, taking present worth into account. The result is multiplied by the capital recovery factor to obtain the levellized energy cost. Levellized annual peak load is similarly determined.

Following are equations for determining levellized annual peak load and levellized annual energy costs:

3. Determination of Levellized Annual Peak Load (PL)*

$$(PL)^2 = \frac{(PL_I)^2}{(1+i)^n} \left[\frac{(1+i)^n - (1+g)^{2n}}{(1+i) - (1+g)^2} \right] CRF_n$$

PL_I - is the anticipated peak load during the first year of installation expressed as a decimal equivalent.

g - is the decimal equivalent of the estimated annual percentage increase in peak load during the life of the transformer.

i - the average rate of interest which the borrower determines is being paid on loans.

n - the number of years which the transformer will be in service.

p - the estimated average increase in energy cost per annum during the useful life of the transformer.

CRF_n - the capital recovery factor is the term that "levellizes" the total present worth evaluation. It converts the sum into a uniform annual series whose total present worth is identical to the actual present worth.

*Note: $(PL)^2$ is used in the calculations, instead of PL since $(PL)^2$ is used in the basic formula.

$$CRF_n = \frac{i\,(1 + i)^n}{(1 + i)^n - 1}$$

For the following example several assumptions are made:

5 kVA transformer
30 year life
Initial peak load: 80% of rating or .8
Load Growth (g) = 3%/Yr or .03
Interest Rate (i) = 11%/Yr or .11

P - Energy escalation rate for inflation etc. = 6% or .06 of base energy cost. Other values are taken from page 5 or Table I.

$$CRF_{30} = \frac{.11\,(1 + .11)^{30}}{(1 + .11)^{30} - 1} = \frac{.11\ (22.89)}{22.89 - 1} = .115$$

$$(PL)^2 = \frac{(.8)^2}{(1 + .11)^{30}} \left[\frac{(1 + .11)^{30} - (1 + .03)^{60}}{1 + .11 \quad - (1 + .03)^2}\right] .115$$

$$(PL^2) = \frac{.640}{22.89} \left[\frac{22.89 - 5.89}{1.11 - 1.06}\right] .115$$

$(PL)^2$ = 1.09 (The square of the levellized Annual Peak Load expressed in per unit of nameplate transformer rating)

4 <u>Determination of Levellized Annual Energy and Demand Costs</u>

(b) excitation loss cost = $\frac{Watts_{NL}}{1000}$ (SC + 8760 (EC))

SC_I = \$91/kW-Year initial demand cost per kW-Year from Table I

EC_I = \$.014/kWh the initial energy cost from Table I

$$SC = SC_I \left[\frac{(1 + i)^n - (1 + p)^n}{(1 + i)^n \ (i - p)}\right] CRF_n$$

$$= \$91 \left[\frac{(1 + .11)^{30} - (1.06)^{30}}{(1.11)^{30} \quad (.11 - .06)}\right] .115$$

$$= \$91 \left[\frac{22.89 - 5.74}{(22.89)\ (.05)}\right] .115$$

$$= \$91 \ (1.72) = \$156.52/\text{kW-YR}$$

$EC = EC_I \ (1.72)$

$EC = .014\ (1.72) = \$.024/\text{kWh}$

LF = .104 (taken from the example in Appendix B)

RF = .55 from Table I.

The total annual cost of owning a transformer can now be calculated.

(a) Fixed Charges

$$= FC(BP)$$
$$= .18\ (\$380)$$
$$= \underline{\underline{\$68.40/Yr}}$$

(b) Excitation Loss Cost

$$= \frac{Watts_{nl}}{1000}\left[SC + 8760\ (EC)\right]$$
$$= \frac{40}{1000}\left[\$156.52 + (8760 \times \$0.024)\right]$$
$$= .04\ (156.52 + \$210.24)$$
$$= \underline{\underline{\$14.67/Yr}}$$

(c) Load Loss Cost

$$= \frac{Watts_{LL}}{1000}\left[(PL)^2\ (SC)\ (RF) + 8760\ (LF)\ EC)\right]$$
$$= .100\left[(1.09)\ (156.52)\ (.55) + 8760\ (.104)\ (.024)\right]$$
$$= .109\ \ (86.09 + \$21.86)$$
$$= \underline{\underline{\$11.77/Yr}}$$

(d) Annual Levellized Cost

$$= (a) + (b) + (c)$$
$$= \$68.40 + \$14.67 + \$11.77$$
$$= \underline{\underline{\$94.84}}$$

This value would be compared with a value similarly determined for a 5 kVA transformer made by another manufacturer. The transformer with the lowest levellized annual cost would be the most economical lifetime investment.

PART II

B. Determination of Equivalent First Cost Using Evaluation Form and Tables

The levellized annual cost obtained in Part I is in the form:

Levellized annual cost = (Transformer price x fixed charge) + Cost of Annual No Load Losses + Cost of Annual Load Losses
= ($380 x .18) + $14.67 + $11.77

To obtain the equivalent first cost, the right hand side of the formula is divided by the carrying charges so that:

$$\text{Equivalent first cost} = \$380 + \frac{\$14.67 + 11.77}{.18}$$
$$= \$380 + \$81.50 + \$65.39$$
$$= \underline{\underline{\$526.89}}$$

Although both the annual cost method and the equivalent first cost method are equally acceptable, the equivalent first cost is usually preferred.

A calculation form (Exhibit I) illustrates how the equivalent first cost can be determined for the 5 kVA transformer in Part I using Tables II and III at the end of this bulletin. A blank copy of the calculation form is included in Appendix C.

It is recommended that the calculation form and the tables be used to determine transformer costs for your system. They give a reasonably accurate estimate of the equivalent first cost, calculations are minimal and the procedure is routine.

PART III

C. The Present Worth Method to Determine Annual Costs

A present worth evaluation is done on a year-by-year basis which involves many calculations. It is, the "technically" correct method, and the results obtained are the most accurate. It is shown here only for the purpose of illustrating that the results obtained by the other two methods compare favorably with the results using the present worth method.

1. Core Loss: The same formulas and assumptions used in the two previous computations are used here, but the increases in costs are calculated annually as shown in the following examples. Sample calculations are shown for the first three years only. Exhibit II tabulates the 30-year present worth costs.

   (a) Demand Cost

   $$\frac{\text{Watts}}{1000}_{NL} \times SC \times DE^*$$

   First Year $\frac{40}{1000} \times (\$91) = \$3.64$ (Note: No demand charge escalation in the first year.)

   Second Year $\frac{40}{1000} \times (\$91 \times 1.06) = \$3.86$

   Third Year $\frac{40}{1000} \times (\$96.46 \times 1.06) = \$4.09$

   (b) Energy Cost

   $$\frac{\text{Watts}}{1000}_{NL} \times 8760 \times EC \times P$$

   First Year $\frac{40}{1000} \times 8760 \times \$.014 = \$4.91$ (Note: No energy charge escalation in the first year.)

   Second Year $\frac{40}{1000} \times (8760)\ (.014 \times 1.06) = \$5.20$

   Third Year $.04 \times 8760 \times (\$.0148 \times 1.06) = \$5.51$

2 Load Loss: In addition to energy and demand charge increases, the loss increases due to customer increase in kilowatt hour usage are also calculated on an annual basis.

   (c) Demand Cost

   $$\frac{\text{Watts}}{1000}_{LL}\ (PL \times g)^2\ (SC \times DE)\ \ (RF)$$

*Demand charge escalation (Assumed in this example to escalate at the same rate as the energy charge = 6% or .06)

First Year $\frac{100}{1000}(.8)^2 \times \$91 \times .55 = \underline{\underline{\$3.20}}$ (Note: No load increase assumed until beginning of second year)

Second Year $\frac{100}{1000}(.8 \times 1.03)^2 \times \$91\ (1.06) \times .55 =$

$.1 \times .679 \times \$96.46 \times .55 = \underline{\underline{\$3.60}}$

Third Year $\frac{100}{1000} \times (.824 \times 1.03)^2 \times \$96.46 \times 1.06 \times .55 = \underline{\underline{\$4.05}}$

(d) Energy Cost

$\frac{\text{Watts}_{LL}}{1000}\ (PL \times g)^2 (8760)(LF)(ECxp)$

First Year $\frac{100}{1000}(.8)^2\ (8760)\ (.104)\ (\$.014) = \underline{\$.82}$

Second Year $\frac{100}{1000}(.8 \times 1.03)^2\ (8760 \times (.104)\ (.014 \times 1.06) =$

$.1 \times .679 \times 8760 \times .104 \times \$.0148 = \underline{\$.92}$

Third Year $.1\ (.824 \times 1.03)^2 \times 8760\ (.104)\ (.0148 \times 1.06) = \underline{\underline{\$1.0}}$

3 Total Annual Costs

First Year	68.40 + \$3.64 + 4.91 + 3.20 + .82 = \$80.97
Second Year	68.40 + \$3.86 + 5.20 + 3.60 + .92 = \$81.98
Third Year	68.40 + \$4.09 + 5.51 + 4.05 + 1.03 = \$83.08

Present Worth at an interest rate of 11% must be taken into account.

First Year	80.97 x	.9009*	= \$72.95
Second Year	81.98 x	.8116*	= \$66.53
Third Year	83.08 x	.7312*	= \$60.75

Exhibit II shows the computations for 30 years.

The levellized annual cost using the present worth method is \$98.30 per year. (from Exhibit II). The annual cost, determined using the equations in Part I, is \$94.84. The reason for this discrepancy is that in Part I, the two levelized variables of load and energy costs are multiplied together in determining the costs of load losses. This causes the cost of load losses to be slightly lower than they actually are. Using the present worth method in Part III, the costs are added each year, thus avoiding this error.

*Must be obtained from a table of present worth values, not included with this guide.

However, the loss evaluation method shown in Exhibit I is sufficiently accurate to compare the relative costs of transformers manufacturers.

IV. DISCUSSION

There are several decisions which should be made and actions which should be taken to be certain an evaluation is fair and that value is received for extra money paid.

1. The kind of loss data required must be stated so the manufacturers will bid on an equal basis. Manufacturers can submit average losses, guaranteed losses or maximum guaranteed losses. Guaranteed losses appear to be what the greatest number of utilities ask for, although average losses will give a more meaningful and closer comparison. Maximum guaranteed losses should not be used for a transformer evaluation because 98 percent of transformers have losses which are below maximum guaranteed. The maximum guaranteed losses are so much greater than average, that they will not yield realistic results or provide a meaningful comparison of competitors.

2. When manufacturers are requested to bid transformers, they will ask for system characteristics such as energy and demand charges in dollars per kilowatt, and transformer initial and final loading. From the data, each manufacturer will determine the most competitive low loss transformer for the system. Recommendations for maximum allowable core losses are given in Appendix F.

3. Since there are many transformer designs (some manufacturers have several core and coil designs for one particular kVA size), the borrower should be certain that transformers which are offered are in REA Bulletin 43-5, "List of Materials Acceptable for Use on Systems of REA Electrification Borrowers" (List), and in accordance with REA Specification D-10. In particular, transformer core and copper losses should be not greater than those given in Appendix G of this guideline and Telephone Influence Factor (TIF) should meet the requirements of Specification D-10. See Appendix D for a discussion of why it is so important to buy only transformers which have acceptable TIF.

4. A manufacturer who is awarded a contract to supply transformers should be required to supply a certified test report for each transformer shipped, to see that the group average loss meets the loss data supplied to get the bid.

5. It is advisable to shop test, or field test, a certain percentage of transformers for losses to see that they correspond with the test reports. Suitable test equipment to do this can be purchased at prices ranging upwards from $2000. Standard meters are not suitable for checking either core or copper losses of transformers since the transformers relatively small core or copper losses cannot be read by a standard meter. Losses determined by testing should be compared to the ANSI Table of acceptable transformer loss variation in Appendix E.

6. In doing transformer evaluations, it should be borne in mind that the input data used should be for your particular system and should be as accurate as possible. Demand and energy costs in particular should be kept updated. If the input data is kept updated and correct, the right low loss transformers will be purchased, and the extra money invested in them will be more than recovered in reduced costs of system losses.

EXHIBIT I
Distribution Transformer Loss Evaluation

Compute the no load loss and load loss evaluation factors by following these steps:

1.	Record your present demand charge	$91/kW
2.	Record your present energy charge	$.014/kWh
3.	Record estimate of demand/energy escalation	6%
4.	Record your estimate of interest rate	11%
5.	Record economic life of transformer	30Yrs.
6.	Select Levellizing factor from Table II using:	

I. energy escalation (line 3)
II. interest rate (line 4)
III. transformer life (line 5)

Select levellizing factor (Table II on page 27) 1.72

7. Levellized demand charge =

Present demand charge (line 1)	$ 91/kW	
xLevellizing factor (line 6)	1.72	
=		$156.52/kW

8. Levellized energy charge =

Present energy charge (line 2)	$.014/kWh	
xLevellizing factor (line 6)	1.72	
=		$.024/kW

9. Annual cost of no load losses = I + II

I. Levellized demand charge (line 7)	$156.52/kW	
II. Levellized energy charge (line 8) x 8760 Hrs/Yr.	$210.24/kW	
ANNUAL COST PER kW OF NO LOAD LOSSES		$366.76/kW

10. (Levellized peak load)^2 = (PL)^2

From Table III using:

I.	Transformer Installation Point	.8XRated Load
II.	Transformer Change Out Point	1.8XRated Load
III.	Interest rate (Line 4)	11%
IV.	Transformer life (Line 5)	30 Yrs.
V.	Anticipated Load Growth Per Yr.	3%

Select (PL)^2 from Table III 1.10

11. Record responsibility factor (RF) .55

12. Record loss factor (LF) for typical load cycles .104

13. Annual cost of load losses =

$(PL)^2$ (SC x RF) + (8760 x EC x LF)	
$(PL)^2$ (line 10)	1.10
(SC) (line 7)	$156.52/kW
RF (line 11)	.55
8760 Hours/Yr.	8760
EC (line 8)	$.024/kWh
LF (line 12)	.104

$(PL)^2$ (SC x RF) + (8760 x EC x LF)
1.10 (156.52 x .55) + (8760 x .024 x .104)
1.10 (86.09 + 21.86)
1.10 (107.95) =

Annual Cost Per kW of Load Losses $118.74/kW

14. Record carrying charge .18

15. $\frac{\text{Annual cost of no load losses (line 9)}}{\text{Carrying charge (line 14)}} = \frac{\$366.76}{.18} = \$2037.56/\text{kW}$

16. $\frac{\text{Annual cost of load losses (line 13)}}{\text{Carrying charge (line 14)}} = \frac{\$118.74}{.18} = \$659.67/\text{kW}$

17. Equivalent first cost =

Transformer price + (Line 15 x No Load Loss)
+ (Line 16 x Full Load Loss)

I.	Transformer Price (BP)	$380
II.	Line 15 x No Load Loss (in kW)	$2037.56 x .04
III.	Line 16 x Full Load Loss (in kW)	$ 659.67 x .1

I + II + III
$380 + $81.50 + $65.97 =
Equivalent First Cost = $527.47

EXHIBIT II
Determination of 30-Year Present Worth Costs of a 5 kVA Transformer Costing $380

Year	Load 3% Growth	$(Load)^2$	Demand Charge Escalation 6%	Energy Charge Escalation 6%	Core Loss Demand	Cost Energy	Load Loss Demand	Cost Energy	Total Loss Costs	Present Worth Factor 11%	Present Worth Cost of Losses	Present Worth of Fixed Charges	Total Present Worth
1	.800	.640	$ 91.00	$ .0140	3.64	4.91	3.20	.82	12.57	.9009	11.32	61.62	72.94
2	.824	.679	96.46	.0148	3.86	5.20	3.60	.92	13.53	.8116	11.02	55.51	66.53
3	.849	.721	102.25	.0157	4.09	5.51	4.05	1.03	14.68	.7312	10.73	50.01	60.74
4	.874	.764	108.38	.0167	4.34	5.58	4.55	1.16	15.90	.6587	10.47	45.06	55.53
5	.900	.810	114.89	.0177	4.60	6.20	5.12	1.31	17.23	.5935	10.23	40.60	50.83
6	.927	.859	121.78	.0187	4.87	6.57	5.75	1.46	18.65	.5346	9.97	36.57	46.54
7	.955	.912	129.09	.0199	5.16	6.96	6.48	1.65	20.25	.4817	9.75	32.95	42.70
8	.984	.968	136.83	.0211	5.47	7.38	7.28	1.86	21.99	.4339	9.54	29.68	39.22
9	1.01	1.02	145.04	.0223	5.80	7.83	8.14	2.17	23.94	.3909	9.36	26.74	36.10
10	1.04	1.08	153.74	.0237	6.15	8.30	9.13	2.34	25.92	.3522	9.13	24.09	33.22
11	1.08	1.17	162.97	.0251	6.52	8.79	10.49	2.68	28.48	.3173	9.04	21.70	30.74
12	1.11	1.23	172.75	.0266	6.91	9.32	11.69	2.98	30.90	.2858	8.83	19.55	28.38
13	1.14	1.30	183.11	.0282	7.32	9.88	13.09	3.34	33.63	.2575	8.66	17.61	26.27
14	1.17	1.37	194.10	.0299	7.76	10.47	14.63	3.73	36.59	.2320	8.49	15.87	24.36
15	1.21	1.46	205.74	.0317	8.23	11.10	16.52	4.22	40.07	.2090	8.37	14.30	22.67
16	1.25	1.56	218.09	.0336	8.72	11.77	18.71	4.78	43.98	.1883	8.28	12.88	21.16
17	1.28	1.64	231.17	.0356	9.25	12.47	20.85	5.32	47.89	.1696	8.12	11.60	19.72
18	1.32	1.74	245.04	.0377	9.80	13.22	23.45	5.98	52.45	.1528	8.01	10.45	18.46

EXHIBIT II (Cont'd)
Determination of 30-Year Present Worth Costs
of a 5 kVA Transformer Costing $380

Year	Load 3% Growth	Load	Demand Charge Escalation 6%	Energy Charge Escalation 6%	Core Loss Cost Demand	Core Loss Cost Energy	Load Loss Cost Demand	Load Loss Cost Energy	Total Loss Costs	Present Worth Factor 11%	Present Worth Cost of Losses	Present Worth of Fixed Charges	Total Present Worth
19	1.36	1.85	$259.74	$.0400	$10.39	$14.01	$26.43	$ 6.74	$57.57	.1377	$ 7.93	$ 9.42	$17.35
20	1.40	1.96	275.33	.0424	11.01	14.86	29.68	7.57	63.12	.1240	7.83	8.48	16.31
21	1.44	2.07	291.85	.0449	11.67	15.75	33.23	8.47	69.12	.1117	7.72	7.64	15.36
22	1.49	2.22	309.36	.0476	12.37	16.69	37.77	9.63	76.46	.1007	7.70	6.89	14.59
23	1.53	2.34	327.92	.0504	13.12	17.69	42.20	10.74	83.75	.0907	7.60	6.20	13.80
24	1.58	2.50	347.60	.0535	13.90	18.75	47.80	12.19	92.64	.0817	7.57	5.59	13.16
25	1.63	2.66	368.45	.0567	14.74	19.88	53.90	13.74	102.26	.0736	7.53	5.03	12.56
26	1.68	2.82	390.56	.0601	15.62	21.07	60.58	15.44	112.71	.0663	7.47	4.53	12.00
27	1.73	2.99	413.99	.0637	16.56	22.34	68.08	17.35	124.33	.0597	7.42	4.08	11.50
28	1.78	3.17	438.83	.0675	17.55	23.68	76.51	19.49	137.23	.0538	7.38	3.68	11.06
29	1.83	3.35	465.16	.0716	18.61	25.10	85.71	21.35	151.27	.0485	7.34	3.32	10.66
30	1.89	3.57	493.07	.0759	19.72	26.60	96.81	24.69	167.82	.0437	7.33	2.99	10.32
											$260.14	$594.64	$854.78

Capital Recovery Factor 11%, 30 Yrs. $= \dfrac{i\,(1+i)^n}{(1+i)^n-1} = \dfrac{.11(1.11)^{30}}{(1.11)^{30}-1} = .115$

Levellized Annual Cost = .115 x $854.78 = $98.30

TABLE I

Values for Various System Parameters Obtained in 1978 EEI Survey

	Range	Average
Energy cost, dollars per kWh	.005-.030	.014
Annual capacity charges, dollars per KW-yr(SC)	20-145	91**
Peak responsibility factor (RF)	.20-.90	.55***
Per unit loss factor	.10-.30	.18
Fixed charge rate (FC)	.13-.23	.18
% Peak load (levellized) (PL)	88-140	115
Capacity factor (CF)*	.19-.34	.27

* From National Survey of Investor-Owned Utilities conducted by General Electric.

** For a system which purchases and distributes power, this corresponds to a monthly demand charge, to the system, by the supplier, of $7.58 per kW per month.

*** See APPENDIX A for explanation of how this varies for cooperatives.

TABLE II

ESCALATION FACTORS FOR INFLATION

I = 7%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.62	1.76	1.93	2.12	2.32	2.56	2.82	20
25	1.80	2.00	2.25	2.53	2.85	3.22	3.66	25
30	1.98	2.26	2.59	2.99	3.47	4.04	4.73	30
35	2.16	2.53	2.97	3.52	4.20	5.05	6.09	35

I = 8%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.59	1.73	1.89	2.06	2.26	2.48	2.72	20
25	1.75	1.94	2.17	2.43	2.73	3.07	3.47	25
30	1.91	2.16	2.47	2.83	3.26	3.78	4.39	30
35	2.06	2.38	2.78	3.27	3.86	4.60	5.52	35

I = 9%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.56	1.70	1.84	2.01	2.20	2.40	2.63	20
25	1.70	1.89	2.10	2.34	2.61	2.93	3.30	25
30	1.84	1.07	2.35	2.68	3.07	3.53	4.08	30
35	1.97	2.26	2.61	3.04	3.56	4.21	5.00	35

TABLE II (Cont'd)

ESCALATION FACTORS FOR INFLATION

I = 10%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.54	1.66	1.80	1.96	2.14	2.33	2.55	20
25	1.66	1.83	2.03	2.25	2.50	2.80	3.13	25
30	1.78	1.99	2.25	2.54	2.89	3.31	3.80	30
35	1.88	2.14	2.46	2.84	3.30	3.86	4.56	35

I = 11%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.51	1.63	1.77	1.91	2.08	2.26	2.47	20
25	1.62	1.78	1.96	2.17	2.40	2.67	2.98	25
30	1.72	1.92	2.15	2.42	2.73	3.11	3.55	30
35	1.81	2.04	2.32	2.66	3.07	3.56	4.16	35

I = 12%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.49	1.60	1.73	1.87	2.03	2.20	2.39	20
25	1.59	1.74	1.90	2.09	2.31	2.56	2.85	25
30	1.67	1.85	2.06	2.31	2.59	2.93	3.33	30
35	1.74	1.95	2.20	2.50	2.86	3.30	3.82	35

TABLE II (Cont'd)

ESCALATION FACTORS FOR INFLATION

I = 13%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.47	1.58	1.70	1.83	1.97	2.14	2.32	20
25	1.55	1.69	1.85	2.03	1.23	2.46	2.72	25
30	1.63	1.79	1.98	2.20	2.46	2.77	3.12	30
35	1.68	1.87	2.10	2.36	2.68	3.06	3.52	35

I = 14%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.45	1.55	1.66	1.79	1.93	2.08	2.25	20
25	1.52	1.65	1.80	1.96	2.15	2.36	2.60	25
30	1.58	1.74	1.91	2.11	2.35	2.62	2.94	30
35	1.63	1.80	2.00	2.24	2.52	2.86	3.27	35

I = 15%

ESCALATION RATES

YRS	6%	7%	8%	9%	10%	11%	12%	YRS
20	1.43	1.52	1.63	1.75	1.88	2.03	2.19	20
25	1.49	1.61	1.75	1.90	2.08	2.27	2.49	25
30	1.55	1.68	1.85	2.03	2.24	2.49	2.78	30
35	1.58	1.74	1.92	2.13	2.38	2.68	3.04	35

TABLE III

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.88	1.04	1.20	1.22	1.19	1.2	20
25	0.77	0.94	1.16	1.16	1.21	1.25	1.34	25
30	0.79	0.99	1.13	1.17	1.25	1.24	1.31	30
35	0.80	1.04	1.13	1.19	1.27	1.25	1.34	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.87	1.02	1.18	1.21	1.18	1.26	20
25	0.76	0.92	1.13	1.15	1.20	1.23	1.32	25
30	0.78	0.97	1.11	1.15	1.23	1.23	1.30	30
35	0.79	1.01	1.10	1.17	1.25	1.23	1.32	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.86	1.01	1.15	1.19	1.17	1.24	20
25	0.75	0.90	1.10	1.13	1.19	1.22	1.30	25
30	0.77	0.95	1.08	1.13	1.21	1.22	1.28	30
35	0.78	0.98	1.08	1.15	1.22	1.22	1.30	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.85	0.99	1.13	1.17	1.16	1.23	20
25	0.75	0.89	1.07	1.11	1.17	1.20	1.28	25
30	0.76	0.92	1.06	1.11	1.20	1.20	1.27	30
35	0.77	0.95	1.06	1.13	1.20	1.20	1.28	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.84	0.97	1.11	1.16	1.15	1.22	20
25	0.74	0.88	1.05	1.09	1.15	1.18	1.27	25
30	0.75	0.91	1.04	1.10	1.18	1.19	1.26	30
35	0.76	0.93	1.04	1.11	1.18	1.19	1.27	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.83	0.96	1.09	1.14	1.14	1.21	20
25	0.74	0.86	1.02	1.08	1.14	1.17	1.25	25
30	0.75	0.89	1.02	1.08	1.16	1.17	1.24	30
35	0.75	0.91	1.02	1.09	1.16	1.17	1.25	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.82	0.95	1.07	1.12	1.13	1.20	20
25	0.73	0.85	1.00	1.06	1.12	1.15	1.23	25
30	0.74	0.87	1.00	1.06	1.14	1.16	1.23	30
35	0.75	0.89	1.00	1.07	1.15	1.16	1.23	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.93	1.05	1.11	1.12	1.18	20
25	0.73	0.84	0.98	1.04	1.11	1.14	1.22	25
30	0.74	0.86	0.98	1.05	1.12	1.14	1.21	30
35	0.74	0.87	0.98	1.05	1.13	1.14	1.22	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.92	1.03	1.09	1.10	1.17	20
25	0.72	0.83	0.96	1.03	1.09	1.13	1.20	25
30	0.73	0.85	0.96	1.03	1.10	1.13	1.20	30
35	0.73	0.86	0.96	1.04	1.11	1.13	1.20	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.88	1.04	1.25	1.36	1.33	1.34	20
25	0.77	0.94	1.16	1.30	1.32	1.34	1.41	25
30	0.79	0.99	1.25	1.28	1.34	1.42	1.41	30
35	0.80	1.04	1.23	1.29	1.38	1.39	1.41	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.87	1.02	1.22	1.33	1.32	1.33	20
25	0.76	0.92	1.13	1.27	1.30	1.33	1.39	25
30	0.78	0.97	1.21	1.25	1.31	1.39	1.39	30
35	0.79	1.01	1.19	1.26	1.35	1.37	1.39	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.86	1.01	1.20	1.31	1.30	1.31	20
25	0.75	0.90	1.10	1.24	1.28	1.31	1.37	25
30	0.77	0.95	1.17	1.23	1.29	1.36	1.37	30
35	0.78	0.98	1.16	1.23	1.32	1.35	1.37	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.85	0.99	1.17	1.28	1.28	1.30	20
25	0.75	0.89	1.07	1.21	1.26	1.29	1.35	25
30	0.76	0.92	1.13	1.20	1.27	1.34	1.35	30
35	0.77	0.95	1.12	1.21	1.30	1.32	1.35	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.84	0.97	1.14	1.25	1.26	1.28	20
25	0.74	0.88	1.05	1.18	1.24	1.27	1.33	25
30	0.75	0.91	1.10	1.18	1.24	1.31	1.33	30
35	0.76	0.93	1.09	1.8	1.27	1.30	1.33	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.83	0.96	1.12	1.23	1.24	1.27	20
25	0.74	0.86	1.02	1.16	1.21	1.25	1.31	25
30	0.75	0.89	1.27	1.15	1.22	1.29	1.31	30
35	0.75	0.91	1.06	1.15	1.24	1.28	1.31	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.82	0.95	1.10	1.20	1.23	1.26	20
25	0.73	0.85	1.00	1.13	1.19	1.23	1.29	25
30	0.74	0.87	1.04	1.13	1.20	1.26	1.29	30
35	0.75	0.89	1.04	1.13	1.22	1.26	1.30	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.93	1.08	1.18	1.21	1.24	20
25	0.73	0.84	0.98	1.11	1.17	1.22	1.27	25
30	0.74	0.86	1.01	1.10	1.18	1.24	1.27	30
35	0.74	0.87	1.01	1.11	1.19	1.24	1.28	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.92	1.06	1.16	1.19	1.23	20
25	0.72	0.83	0.96	1.08	1.15	1.20	1.25	25
30	0.73	0.85	0.99	1.08	1.16	1.22	1.26	30
35	0.73	0.86	0.99	1.08	1.17	1.22	1.26	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.88	1.04	1.25	1.52	1.52	1.54	20
25	0.77	0.94	1.16	1.46	1.45	1.48	1.55	25
30	0.79	0.99	1.28	1.42	1.44	1.52	1.65	30
35	0.80	1.04	1.31	1.41	1.47	1.58	1.62	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.87	1.02	1.22	1.48	1.49	1.51	20
25	0.76	0.92	1.13	1.41	1.42	1.46	1.52	25
30	0.78	0.97	1.23	1.38	1.41	1.49	1.61	30
35	0.79	1.01	1.26	1.37	1.44	1.54	1.59	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.74	0.86	1.01	1.20	1.44	1.46	1.49	20
25	0.75	0.90	1.10	1.36	1.39	1.43	1.50	25
30	0.77	0.95	1.19	1.34	1.38	1.46	1.58	30
35	0.78	0.98	1.22	1.33	1.40	1.50	1.56	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.85	0.99	1.17	1.40	1.43	1.47	20
25	0.75	0.89	1.07	1.32	1.36	1.41	1.48	25
30	0.76	0.92	1.15	1.30	1.35	1.43	1.54	30
35	0.77	0.95	1.17	1.29	1.37	1.47	1.53	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.84	0.97	1.14	1.36	1.40	1.44	20
25	0.74	0.88	1.05	1.28	1.33	1.38	1.45	25
30	0.75	0.91	1.11	1.26	1.32	1.40	1.51	30
35	0.76	0.93	1.13	1.26	1.34	1.43	1.49	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.73	0.83	0.96	1.12	1.32	1.37	1.42	20
25	0.74	0.86	1.02	1.24	1.30	1.36	1.43	25
30	0.75	0.89	1.08	1.22	1.30	1.37	1.47	30
35	0.75	0.91	1.10	1.22	1.31	1.40	1.47	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.80 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.82	0.95	1.10	1.29	1.34	1.39	20
25	0.73	0.85	1.00	1.20	1.27	1.33	1.40	25
30	0.74	0.87	1.05	1.19	1.27	1.35	1.44	30
35	0.75	0.89	1.06	1.19	1.28	1.37	1.44	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.93	1.08	1.26	1.31	1.37	20
25	0.73	0.84	0.98	1.17	1.24	1.31	1.38	25
30	0.74	0.86	1.02	1.16	1.24	1.32	1.41	30
35	0.74	0.87	1.03	1.16	1.25	1.34	1.41	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.72	0.81	0.92	1.06	1.23	1.29	1.35	20
25	0.72	0.83	0.96	1.13	1.21	1.28	1.36	25
30	0.73	0.85	1.00	1.13	1.21	1.29	1.38	30
35	0.73	0.86	1.01	1.13	1.22	1.31	1.38	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.11	1.32	1.34	1.35	1.39	1.49	20
25	0.97	1.18	1.32	1.34	1.40	1.41	1.45	25
30	1.00	1.25	1.31	1.37	1.40	1.41	1.49	30
35	1.02	1.26	1.32	1.38	1.40	1.43	1.47	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.10	1.30	1.33	1.34	1.38	1.47	20
25	0.96	1.16	1.30	1.32	1.38	1.40	1.44	25
30	0.98	1.22	1.29	1.35	1.38	1.40	1.47	30
35	1.00	1.23	1.30	1.36	1.38	1.41	1.46	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.08	1.27	1.31	1.33	1.37	1.46	20
25	0.95	1.14	1.28	1.31	1.37	1.39	1.43	25
30	0.97	1.20	1.27	1.34	1.37	1.39	1.46	30
35	0.99	1.20	1.28	1.34	1.37	1.40	1.45	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.07	1.25	1.30	1.32	1.36	1.44	20
25	0.95	1.13	1.26	1.30	1.35	1.37	4.42	25
30	0.96	1.17	1.25	1.32	1.35	1.38	1.44	30
35	0.98	1.17	1.26	1.33	1.36	1.39	1.44	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.06	1.23	1.28	1.31	1.35	1.43	20
25	0.94	1.11	1.24	1.28	1.34	1.36	1.41	25
30	0.95	1.15	1.23	1.30	1.34	1.36	1.43	30
35	0.96	1.15	1.24	1.31	1.34	1.37	1.44	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.05	1.21	1.27	1.30	1.34	1.42	20
25	0.93	1.09	1.22	1.27	1.33	1.35	1.40	25
30	0.95	1.12	1.22	1.29	1.33	1.35	1.42	30
35	0.95	1.13	1.22	1.29	1.33	1.36	1.41	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.04	1.20	1.25	1.28	1.33	1.40	20
25	0.93	1.08	1.20	1.26	1.31	1.34	1.39	25
30	0.94	1.10	1.20	1.27	1.31	1.34	1.40	30
35	0.94	1.11	1.20	1.27	1.31	1.35	1.40	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.03	1.18	1.24	1.27	1.31	1.39	20
25	0.92	1.06	1.18	1.24	1.30	1.33	1.38	25
30	0.93	1.09	1.18	1.25	1.30	1.33	1.39	30
35	0.94	1.09	1.19	1.26	1.30	1.33	1.39	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.02	1.16	1.23	1.26	1.30	1.38	20
25	0.92	1.05	1.17	1.23	1.28	1.31	1.37	25
30	0.92	1.07	1.17	1.24	1.29	1.32	1.38	30
35	0.93	1.07	1.17	1.24	1.29	1.32	1.37	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.11	1.32	1.52	1.55	1.51	1.60	20
25	0.97	1.18	1.47	1.47	1.54	1.58	1.69	25
30	1.00	1.25	1.43	1.48	1.59	1.58	1.66	30
35	1.02	1.32	1.43	1.51	1.60	1.58	1.69	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.10	1.30	1.49	1.53	1.50	1.59	20
25	0.96	1.16	1.43	1.45	1.52	1.56	1.67	25
30	0.98	1.22	1.40	1.45	1.56	1.56	1.64	30
35	1.00	1.28	1.40	1.48	1.58	1.56	1.67	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.08	1.27	1.46	1.50	1.48	1.58	20
25	0.95	1.14	1.39	1.43	1.50	1.54	1.65	25
30	0.97	1.20	1.37	1.43	1.54	1.54	1.63	30
35	0.99	1.24	1.37	1.45	1.55	1.54	1.65	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.07	1.25	1.43	1.48	1.47	1.56	20
25	0.95	1.13	1.36	1.41	1.48	1.52	1.62	25
30	0.96	1.17	1.34	1.41	1.51	1.52	1.61	30
35	0.98	1.21	1.34	1.43	1.52	1.52	1.62	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.06	1.23	1.41	1.46	1.45	1.55	20
25	0.94	1.11	1.33	1.38	1.46	1.50	1.60	25
30	0.95	1.15	1.31	1.39	1.49	1.50	1.59	30
35	0.96	1.18	1.31	1.40	1.50	1.50	1.60	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.05	1.21	1.38	1.44	1.44	1.53	20
25	0.93	1.09	1.30	1.36	1.44	1.48	1.58	25
30	0.95	1.12	1.29	1.37	1.47	1.48	1.57	30
35	0.95	1.15	1.29	1.38	1.47	1.48	1.58	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.04	1.20	1.36	1.42	1.43	1.51	20
25	0.93	1.08	1.27	1.34	1.42	1.46	1.56	25
30	0.94	1.10	1.26	1.34	1.44	1.46	1.55	30
35	0.94	1.13	1.26	1.35	1.45	1.46	1.56	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.03	1.18	1.33	1.40	1.41	1.50	20
25	0.92	1.06	1.24	1.32	1.40	1.44	1.54	25
30	0.93	1.09	1.24	1.32	1.42	1.44	1.53	30
35	0.94	1.10	1.24	1.33	1.43	1.45	1.54	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.02	1.16	1.31	1.38	1.40	1.48	20
25	0.92	1.05	1.22	1.30	1.38	1.42	1.52	25
30	0.92	1.07	1.21	1.30	1.40	1.43	1.51	30
35	0.93	1.08	1.21	1.31	1.40	1.43	1.52	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.11	1.32	1.59	1.72	1.69	1.70	20
25	0.97	1.18	1.47	1.65	1.67	1.70	1.79	25
30	1.00	1.25	1.58	1.62	1.69	1.79	1.79	30
35	1.02	1.32	1.56	1.63	1.75	1.76	1.79	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.94	1.10	1.30	1.55	1.69	1.66	1.68	20
25	0.96	1.16	1.43	1.61	1.65	1.68	1.76	25
30	0.98	1.22	1.53	1.59	1.66	1.76	1.76	30
35	1.00	1.28	1.51	1.59	1.71	1.73	1.76	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.08	1.27	1.51	1.65	1.64	1.66	20
25	0.95	1.14	1.39	1.57	1.62	1.65	1.74	25
30	0.97	1.20	1.48	1.55	1.63	1.73	1.74	30
35	0.99	1.24	1.46	1.56	1.68	1.71	1.74	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.93	1.07	1.25	1.48	1.62	1.62	1.64	20
25	0.95	1.13	1.36	1.53	1.59	1.63	1.71	25
30	0.96	1.17	1.43	1.52	1.60	1.69	1.71	30
35	0.98	1.21	1.42	1.53	1.64	1.68	1.71	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.06	1.23	1.45	1.59	1.60	1.63	20
25	0.94	1.11	1.33	1.50	1.56	1.61	1.68	25
30	0.95	1.15	1.39	1.49	1.58	1.66	1.69	30
35	0.96	1.18	1.38	1.49	1.60	1.65	1.69	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.92	1.05	1.21	1.42	1.55	1.57	1.61	20
25	0.93	1.09	1.30	1.46	1.54	1.59	1.66	25
30	0.95	1.12	1.35	1.46	1.55	1.63	1.66	30
35	0.95	1.15	1.35	1.46	1.57	1.62	1.66	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 0.90 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.04	1.20	1.39	1.52	1.55	1.59	20
25	0.93	1.08	1.27	1.43	1.51	1.56	1.63	25
30	0.94	1.10	1.32	1.43	1.52	1.60	1.64	30
35	0.94	1.13	1.31	1.43	1.54	1.59	1.64	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.03	1.18	1.36	1.50	1.53	1.57	20
25	0.92	1.06	1.24	1.40	1.48	1.54	1.61	25
30	0.93	1.09	1.28	1.40	1.49	1.57	1.61	30
35	0.94	1.10	1.28	1.40	1.51	1.57	1.62	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	0.91	1.02	1.16	1.34	1.47	1.51	1.55	20
25	0.92	1.05	1.22	1.37	1.46	1.52	1.59	25
30	0.92	1.07	1.25	1.37	1.47	1.54	1.59	30
35	0.93	1.08	1.25	1.37	1.48	1.54	1.59	35

TABLE III (Cont'd)

VALUES OF $(\text{LEVELLIZED PEAK LOAD})^2 - (\text{PL})^2$

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.37	1.48	1.49	1.56	1.67	1.56	20
25	1.20	1.46	1.47	1.54	1.57	1.64	1.60	25
30	1.23	1.44	1.49	1.53	1.58	1.67	1.59	30
35	1.26	1.43	1.52	1.53	1.59	1.66	1.60	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.35	1.47	1.48	1.55	1.66	1.56	20
25	1.19	1.44	1.46	1.52	1.56	1.63	1.59	25
30	1.22	1.42	1.48	1.52	1.57	1.66	1.58	30
35	1.24	1.41	1.50	1.52	1.58	1.65	1.59	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.15	1.34	1.46	1.47	1.54	1.65	1.55	20
25	1.18	1.41	1.45	1.51	1.55	1.62	1.58	25
30	1.20	1.40	1.46	1.51	1.56	1.65	1.57	30
35	1.22	1.39	1.48	1.51	1.57	1.63	1.58	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.32	1.44	1.46	1.53	1.63	1.55	20
25	1.17	1.39	1.43	1.50	1.54	1.61	1.57	25
30	1.19	1.38	1.45	1.50	1.54	1.63	1.57	30
35	1.21	1.38	1.46	1.50	1.55	1.62	1.57	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.31	1.43	1.45	1.52	1.62	1.54	20
25	1.16	1.37	1.42	1.48	1.53	1.60	1.56	25
30	1.18	1.36	1.43	1.48	1.53	1.62	1.56	30
35	1.19	1.36	1.45	1.49	1.54	1.61	1.56	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.30	1.41	1.44	1.51	1.60	1.53	20
25	1.15	1.35	1.41	1.47	1.52	1.59	1.55	25
30	1.17	1.34	1.42	1.47	1.52	1.60	1.55	30
35	1.18	1.34	1.43	1.47	1.53	1.60	1.55	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.60 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.28	1.40	1.43	1.50	1.59	1.53	20
25	1.15	1.33	1.40	1.46	1.51	1.58	1.54	25
30	1.16	1.32	1.41	1.46	1.51	1.59	1.54	30
35	1.17	1.32	1.41	1.46	1.52	1.59	1.54	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.27	1.39	1.43	1.49	1.58	1.52	20
25	1.14	1.31	1.38	1.45	1.50	1.56	1.53	25
30	1.15	1.31	1.39	1.45	1.50	1.58	1.53	30
35	1.16	1.31	1.40	1.45	1.50	1.57	1.53	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.26	1.37	1.42	1.48	1.56	1.51	20
25	1.13	1.30	1.37	1.43	1.49	1.55	1.52	25
30	1.14	1.29	1.38	1.43	1.49	1.56	1.52	30
35	1.15	1.29	1.38	1.44	1.49	1.56	1.52	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.37	1.63	1.65	1.73	1.78	1.84	20
25	1.20	1.46	1.62	1.65	1.77	1.86	1.79	20
30	1.23	1.55	1.61	1.69	1.81	1.83	1.84	20
35	1.26	1.55	1.62	1.70	1.80	1.86	1.82	20

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.35	1.60	1.64	1.72	1.77	1.82	20
25	1.19	1.44	1.60	1.63	1.75	1.84	1.78	25
30	1.22	1.51	1.59	1.67	1.79	1.82	1.82	30
35	1.24	1.51	1.60	1.68	1.78	1.84	1.80	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.15	1.34	1.57	1.62	1.70	1.75	1.80	20
25	1.18	1.41	1.58	1.62	1.74	1.82	1.77	25
30	1.20	1.48	1.57	1.65	1.77	1.80	1.80	30
35	1.22	1.48	1.58	1.66	1.76	1.82	1.79	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.32	1.55	1.60	1.69	1.74	1.78	20
25	1.17	1.39	1.55	1.60	1.72	1.80	1.75	25
30	1.19	1.45	1.55	1.63	1.74	1.78	1.78	30
35	1.21	1.45	1.55	1.64	1.74	1.80	1.77	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.31	1.52	1.58	1.67	1.72	1.77	20
25	1.16	1.37	1.53	1.58	1.70	1.78	1.74	25
30	1.18	1.42	1.52	1.61	1.72	1.76	1.77	30
35	1.19	1.42	1.53	1.61	1.72	1.78	1.76	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.30	1.50	1.57	1.65	1.71	1.75	20
25	1.15	1.35	1.51	1.57	1.68	1.75	1.73	25
30	1.17	1.39	1.50	1.59	1.70	1.75	1.75	30
35	1.18	1.39	1.51	1.59	1.70	1.76	1.74	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 1.80 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.28	1.48	1.55	1.64	1.69	1.73	20
25	1.15	1.33	1.48	1.55	1.66	1.73	1.71	25
30	1.16	1.36	1.48	1.57	1.68	1.73	1.73	30
35	1.17	1.37	1.49	1.57	1.68	1.74	1.73	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.27	1.46	1.53	1.62	1.68	1.71	20
25	1.14	1.31	1.46	1.53	1.64	1.72	1.70	25
30	1.15	1.34	1.46	1.55	1.66	1.71	1.71	30
35	1.16	1.34	1.47	1.55	1.66	1.72	1.71	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.26	1.44	1.51	1.61	1.66	1.70	20
25	1.13	1.30	1.44	1.52	1.62	1.70	1.69	25
30	1.14	1.32	1.44	1.53	1.64	1.69	1.70	30
35	1.15	1.32	1.45	1.53	1.64	1.70	1.70	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 7.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.37	1.63	1.87	1.91	1.86	1.98	20
25	1.20	1.46	1.81	1.82	1.90	1.95	2.09	25
30	1.23	1.55	1.77	1.82	1.96	1.94	2.05	30
35	1.26	1.63	1.76	1.86	1.98	1.95	2.09	35

INTEREST = 8.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.16	1.35	1.60	1.84	1.88	1.85	1.96	20
25	1.19	1.44	1.77	1.79	1.88	1.93	2.06	25
30	1.22	1.51	1.73	1.79	1.99	1.92	2.03	30
35	1.24	1.58	1.72	1.83	1.95	1.92	2.06	35

INTEREST = 9.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.15	1.34	1.57	1.80	1.86	1.83	1.94	20
25	1.18	1.41	1.72	1.76	1.85	1.90	2.03	25
30	1.20	1.48	1.69	1.77	1.90	1.90	2.01	30
35	1.22	1.53	1.69	1.80	1.91	1.90	2.03	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 10.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.32	1.55	1.77	1.83	1.81	1.93	20
25	1.17	1.39	1.68	1.74	1.83	1.88	2.00	25
30	1.19	1.45	1.66	1.74	1.87	1.88	1.98	30
35	1.21	1.49	1.65	1.76	1.88	1.88	2.01	35

INTEREST = 11.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.14	1.31	1.52	1.74	1.81	1.80	1.91	20
25	1.16	1.37	1.64	1.71	1.80	1.85	1.98	25
30	1.18	1.42	1.62	1.71	1.84	1.85	1.96	30
35	1.19	1.45	1.62	1.73	1.85	1.85	1.98	35

INTEREST = 12.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.30	1.50	1.70	1.78	1.78	1.89	20
25	1.15	1.35	1.60	1.68	1.78	1.83	1.95	25
30	1.17	1.39	1.59	1.69	1.81	1.83	1.94	30
35	1.18	1.42	1.59	1.70	1.82	1.83	1.95	35

TABLE III (Cont'd)

VALUES OF (LEVELLIZED PEAK LOAD)^2 -(PL)^2

INSTALLATION AT 1.00 TIMES RATED LOAD
CHANGEOUT AT 2.00 TIMES RATED LOAD

INTEREST = 13.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.13	1.28	1.48	1.67	1.76	1.76	1.87	20
25	1.15	1.33	1.57	1.66	1.76	1.80	1.92	25
30	1.16	1.36	1.56	1.66	1.78	1.81	1.91	30
35	1.17	1.39	1.56	1.67	1.79	1.81	1.93	35

INTEREST = 14.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.27	1.46	1.64	1.73	1.74	1.85	20
25	1.14	1.31	1.53	1.63	1.73	1.78	1.90	25
30	1.15	1.34	1.53	1.63	1.75	1.78	1.89	30
35	1.16	1.36	1.53	1.64	1.76	1.79	1.90	35

INTEREST = 15.0%

ANNUAL PEAK LOAD GROWTH RATE

YRS	1	2	3	4	5	6	7	YRS
20	1.12	1.26	1.44	1.62	1.71	1.72	1.83	20
25	1.13	1.30	1.51	1.61	1.71	1.76	1.87	25
30	1.14	1.32	1.50	1.61	1.73	1.76	1.87	30
35	1.15	1.34	1.50	1.62	1.73	1.76	1.88	35

APPENDIX A

Determination of Peak Loss Responsibility Factor (RF)

The information to determine "RF" may be very difficult to obtain or just not available. In the latter case the information for RF should be taken from Table I.

The peak loss responsibility factor of distribution transformers is a composite which can depend on up to three factors that must be determined or estimated. For a co-operative which purchases power from another utility at distribution voltage only item(a) is applicable. If power is purchased at transmission voltgage items (a) & (b) apply.

(a) The fraction of the transformer's peak load which is being supplied to the transformer at the time of substation peak load.

(b) The fraction of the transformer's peak load which is being supplied to the transformer at the time of the transmission peak load.

(c) The fraction of the transformer peak load which is being supplied to the transformer at the time of system peak load or generation peak.

The above three factors are usually non-coincidental with the transformer peak and are not necessarily coincident with one another. The following are typical values and they are assumed to be non-coincidental.

Time Period	Transformer Load Per Unit of Peak Load	Transformer Load Loss Per Unit of Peak Loss
Distribution Peak Load	.8	.64
Transmission Peak Load	.7	.49
Generation Peak Load	.7	.49
		1.62

$$\text{Peak loss responsibility factor} = \frac{1.62}{3} = .54$$

Depending on the type of co-operative the following responsibility factors are typical:

G & T co-operative	.54
Power purchased at transmission voltage:	.57
Power purchased at distribution voltgage:	.64

APPENDIX B

Loss Factor

The loss factor may be computed using the following formula. Loss factor can apply to a system or can be computed for a specific transformer.

$$LF = 0.16\ CF + .84\ (CF)^2*$$

Where CF is the capacity factor for a specific transformer

$$CF = \frac{\text{kWh sold/Yr. through a transformer}}{8760 \times \text{nameplate kVA}}$$

From Table I the average system capacity factor is CF = .27

$$\begin{aligned} LF &= 0.16 \times .27 + .84\ (.27)^2 \\ &= .043 + .061 \\ &= .104 \end{aligned}$$

NOTE: When evaluating transformers which may be connected for only part of the year, such as those which supply an irrigation pump, the hours of use should be adjusted accordingly.

For example: In determining capacity factor, if an irrigation pump is disconnected for 8 months, 2920 should be used instead of 8760; 2920 being the number of hours it is drawing power from the system.

* Fr. IEEE Conference Paper; 1976 Rural Electric Power Conference, Atlanta, Georgia (D. Eicher & Daverman Associates, Inc.).

APPENDIX C

Distribution Transformer Loss Evaluation

Compute the no load loss and load loss evaluation factors by following these steps:

1. Record your present demand charge ____ ____ ____ ____
2. Record your present energy charge ____ ____ ____ ____
3. Record estimate of demand/energy escalation ____ ____ ____ ____
4. Record your estimate of interest rate ____ ____ ____ ____
5. Record economic life of transformer ____ ____ ____ ____
6. Select levellizing factor from Table II using:

   I. energy escalation (line 3)
   II. interest rate (line 4)
   III. transformer life (line 5)

   Select levellizing factor ____

7. Levellized demand charge =

   Present demand charge (line 1) ____
   xlevellizing factor (line 6) ____
   = ____

8. Levellized energy charge =

   Present energy charge (line 2) ____
   xlevellizing factor (line 6) ____
   = ____

9. Annual cost of no load losses = I + II ____

   I. levellized demand charge (line 7) ____
   II. levellized energy charge (line 8) ____
   X HRS/YR (Usually 8760)

   Annual Cost of No Load Losses ____

10. Levellized peak load = (PL)
    From Table III using:

    I. transformer installation point ____
    II. transformer change out point ____
    III. interest rate (line 4) ____
    IV. transformer life (line 5) ____
    V. anticipated load growth per Yr. ____

    Select $(PL)^2$ from Table III ____

11. Record responsibility factor (RF) ____

APPENDIX C (Continued)

12. Record loss factor (LF) for typical load cycles __ __

13. Annual cost of load losses = $(PL)^2$ (SCXRF) + (HRS/YR x EC x LF)

$(PL)^2$ (line 10) ___ ___ ___ ___
SC (line 7) ___ ___ ___ ___
RF (line 11) ___ ___ ___ ___
Hours/Yr. Energized (usually 8760) ___ ___ ___ ___
EC (line 8) ___ ___ ___ ___
LF (line 12) ___ ___ ___ ___
$(PL)^2$ (SC x RF) + (HRS/YR x EC x LF)

Annual Cost of Load Losses ___ ___ ___ ___

14. Record carrying charge ___ ___ ___ ___

15. $\frac{\text{Annual cost of no load losses (line 9)}}{\text{Carrying charge (line 14)}}$ = ___ ___ ___ ___

16. $\frac{\text{Annual cost of load losses (line 13)}}{\text{Carrying charge (line 14)}}$ = ___ ___ ___ ___

17. Equivalent first cost =

Transformer price + (line 15 x no load loss) + (line 16 x full load loss)

I. Transformer price (BP) ___ ___ ___ ___
II. line 15 x no load loss (in kW) ___ ___ ___ ___
III. line 16 x full load loss (in kW) ___ ___ ___ ___

I + II + III

___ ___ ___ ___ ___ ___ ___ ___

Equivalent First Cost = ___ ___ ___ ___

APPENDIX D

TELEPHONE INFLUENCE FACTOR (TIF) - A DISCUSSION

For noise limitations for transformers manufactured for REA borrowers refer to REA Specification D-10, "Specifications for Rural Distribution Transformers (Overhead Type)". The Telephone Influence Factor (TIF) requirements limit the electrical noise producing capability of transformers and help to minimize objectionable induced noise in communication circuits paralleling the power circuits serving the transformers. Noise possibilities are of special concern in rural areas because prevailing conditions of shared right-of-way (joint use) and long exposures make rural systems more susceptible to severe noise problems.

Whenever power and communication circuits parallel one another, there is a chance for noise problems. Noise, often in the form of buzzing, humming and whirring, is a function of power system susceptiveness. Tolerable co-existence is possible only by coordinated efforts by both power and communication people.

Telephone companies strive to minimize susceptiveness by using only the best equipment and by maintaining the best possible balance. Power and telephone companies try to keep coupling at an economic minimum. However, for environmental and conservation reasons, it has become necessary to share more and more right-of-way and live with increased coupling factors, especially in rural areas.

Power influence describes the noise producing capability of an electric line. Influence is related to power system waveshape distortion. Voltages and currents on an electric line do not have pure 60Hz sinusoidal waveshape symmetry. The usual power system waveshape consists of a 60Hz component and varying numbers and magnitudes of other components whose frequencies are usually odd (but sometimes include even) multiples of the 60Hz component. These harmonic components are created by power apparatus such as transformers, generators or other iron core devices with non-linear saturation characteristics and by solid state load controller devices that distort the waveshape by chopping action. Power line harmonic currents induce voltages and cause harmonic currents to flow in neighboring telephone circuits. Because some harmonics are in the audiofrequency range, unwanted noise and interference are created for the telephone user.

If only high TIF transformers are installed on a distribution system, waveshape distortion gradually worsens, increasing the numbers and magnitudes of potentially interfering harmonic components. A neighboring telephone circuit could be similarly affected and noise could gradually increase. If operating practices remain unchanged, further additions of high TIF transformers could eventually so pollute the telephone system that conversation would be impossible. The problem would be the result of noise contribution from all transformers and other sources and not the fault of individual transformers; for this reason, searching for offending transformers is usually a fruitless and expensive waste of time.

Power system operators owe it to their consumers to take all possible practical measures to limit power system caused distortion and keep harmonics at

APPENDIX D (Cont'd)

tolerable levels. Besides maintaining operating voltages at proper levels (to minimize saturation, distortion and losses caused by excessive voltage levels), power systems can help avoid noise problems by insisting on equipment designed with TIF in mind, perhaps going so far as requesting TIF certification from time to time.

With energy conservation and economizing being top priority concerns today, a closer look at low TIF transformers will show that they are "best buys" in the long run. Low TIF transformers have proven to be low core loss transformers which for lightly loaded rural use means savings. In spite of high initial cost, low TIF transformers, over their life, will prove to be more economical to own and more energy efficient to operate.

APPENDIX E

ANSI TABLE OF ACCEPTABLE TRANSFORMER LOSS VARIATION

A loss evaluation should be based on an entire shipment in accordance with Table 13 of ANSI C57-12.00-1973 reproduced below.

TABLE 13

Tolerances for Transformer Losses

No. of Units on One Order	No. of Phases of Each	Determination	Excitation Losses (Percent)	Total Losses (Percent)
1	Single	1 Unit	10	6
1	Three	1 Unit	0	0
2 or More	Single or Three	Each Unit	10	6
2 or More	Single or Three	Average of all Units	0	0

Individual transformers exceeding the limits for one unit should be rejected. The penalty or bonus should be assessed on the average of the accepted units.

Care must be used in the determination of the load loss values to be used in the evaluation formula. In general, manufacturers guarantee the no load (excitation) loss of a transformer and the total loss of a transformer. The load loss is not normally a guaranteed value.

Appendix F

It is recommended that distribution transformers with low core losses be used for general residential service. For other than residential service, the best loss ratio should be evaluated separately if the transformer will be kept segregated.

Recommended **maximum** acceptable core losses for general residential service are:

kVA	7200 & 7620 Volts	14,400 Volts
5	33	45
10	50	55
15	60	65
25	90	100
37.5	130	140
50	175	185

Recommendations for dual voltage transformers have not been developed yet.

The following tables give the currently listed performance guarantees for distribution transformers as of February 4, 1983. It is realized that there are some transformers missing from this tabulation; however, every effort has been made to make it as complete as possible. Wherever possible, the tables represent conventional type transformers.

7200 Volts
7620 Volts

5 kVA

	Losses-Watts			Cu/Fe	Excit-ation	Imped-ance	% Regulation	
Manufacturer	Fe	Cu	Total	Ratio	I%	%Z	1.00PF	.80PF
ARKANSAS	32.5	86.1	118.6	2.7	.09	1.8	1.63	1.82
HOWARD	30	151	181	5.0	2.4	3.0	2.96	2.78
KUHLMAN	46	102	148	2.2	1.5	2.2	2.04	2.13
RTE	44	106	150	2.4	2.5	2.4	2.15	2.48
SESCO	40	100	140	2.5	2.0	2.1	2.0	2.12
TARRANT	38	107	145	2.8	1.5	2.3	2.1	2.55
VAN TRAN	35	124	159	3.5	2.0	2.5	2.45	2.5

10 kVA

7200 Volts
7620 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit -ation I%	Imped -ance %Z	% Regulation 1.00PF	.80PF
ARKANSAS	55.2	139.6	194.8	2.5	0.7	1.5	1.33	1.63
CENTRAL MOLONEY	59	184	243	3.1	2.3	2.0	1.85	1.95
DOWZER	50	240	290	4.8	1.5	2.6	2.40	2.52
ERMCO	65	140	205	2.2	1.5	1.6	1.5	1.6
G.E.	43	246	289	5.7	0.95	2.6	2.46	2.49
HOWARD	44	262	306	6.0	2.4	2.8	2.58	2.77
KUHLMAN	46	269	315	5.8	1.1	2.9	2.70	2.80
MAGNETIC	70	170	240	2.4	1.8	1.8	1.7	1.72
McGRAW	47	305	352	6.5	0.8	3.4	3.06	3.34
NECO	40	280	320	6.8	1.0	3.0	2.7	3.0
PORTER	45	208	253	4.6	0.8	2.9	2.54	2.88
RTE	45	291	336	6.5	0.8	3.5	2.98	3.45
SESCO	66	149	215	2.3	1.5	1.6	1.49	1.55
TARRANT	60	138	198	2.3	1.0	1.9	1.5	1.75
UNITED (KY.)	38	287	325	7.6	1.0	3.2	2.8	3.1
VAN TRAN	51	221	272	4.3	1.5	2.4	2.2	2.3
WESTINGHOUSE	43	290	333	6.8	1.0	3.3	2.9	3.3

15 kVA

7200 Volts
7620 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	.80PF
ARKANSAS	74.6	228.6	303.2	3.1	0.6	1.8	1.51	1.74
CENTRAL MOLONEY	87	207	294	2.4	2.0	1.7	1.39	1.70
DOWZER	67	313	380	4.7	1.3	2.4	2.08	2.38
ERMCO	76	201	277	2.6	1.5	1.6	1.5	1.6
G.E.	47	342	389	7.3	0.8	2.9	2.30	2.96
HOWARD	56	372	428	6.6	2.1	2.9	2.45	2.88
KUHLMAN	54	415	469	7.7	0.9	3.1	2.78	3.05
MAGNETIC	85	235	320	2.8	1.8	1.8	1.61	2.0
McGRAW	70	345	415	4.9	0.9	2.6	2.31	2.57
NECO	52	360	412	6.9	1.0	3.0	2.4	2.9
PORTER	71	216	287	3.0	0.7	2.2	1.98	2.3
RTE	60	391	451	6.5	0.9	3.1	2.66	3.10
SESCO	80	205	285	2.6	1.0	1.7	1.39	1.52
TARRANT	73	197	270	2.7	1.0	1.8	1.4	1.7
UNITED (KY.)	54	371	425	6.9	1.0	2.9	2.4	2.9
VAN TRAN	64	304	368	4.9	1.3	2.4	2.05	2.4
WESTINGHOUSE	56	344	400	6.1	1.0	2.8	2.3	2.7

25 kVA

7200 Volts
7620 Volts

Manufacturer	Losses-Watts Fe	Losses-Watts Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	% Regulation .80PF
ARKANSAS	112.7	303.5	416.2	2.7	0.8	1.7	1.20	1.80
CENTRAL MOLONEY	109	304	413	2.8	1.3	1.7	1.23	1.69
DOWZER	94	471	565	4.4	1.1	2.3	1.88	2.29
ERMCO	104	315	419	3.0	1.0	1.7	1.3	1.7
G.E.	69	430	499	6.2	0.7	2.8	1.74	2.70
HOWARD	84	557	641	6.6	1.6	2.7	2.20	2.69
KUHLMAN	85	537	622	6.3	0.9	2.8	2.16	2.80
MAGNETIC	110	400	510	3.6	2.0	2.0	1.61	2.0
McGRAW	104	462	566	4.4	0.8	2.2	1.86	2.19
NECO	78	515	593	6.9	1.0	3.2	2.1	3.1
PORTER	87	378	465	4.8	0.5	2.3	1.87	2.29
RTE	87	513	600	5.9	0.8	3.1	2.11	3.02
SESCO	105	320	425	3.0	1.0	1.7	1.3	1.8
TARRANT	110	298	408	2.7	0.9	1.7	1.38	1.75
UNITED (KY.)	76	524	600	6.9	1.0	3.3	2.1	3.2
VAN TRAN	85	367	452	4.3	1.1	2.6	1.9	2.6
WESTINGHOUSE	84	528	612	6.3	0.8	2.8	2.1	2.8

37 1/2 kVA

7200 Volts
7620 Volts

Manufacturer	Losses-Watts Fe	Losses-Watts Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	% Regulation .80PF
DOWZER	155	445	600	2.9	1.0	2.0	1.19	1.91
G.E.	117	351	468	3.0	0.7	1.88	0.95	1.73
HOWARD	133	605	738	4.6	1.7	2.5	1.60	2.42
KUHLMAN	111	669	780	6.0	0.9	2.5	1.80	2.48
McGRAW	150	454	604	3.0	1.0	1.8	1.22	1.77
NECO	125	715	840	5.9	1.0	2.6	1.9	2.5
RTE	122	599	721	4.9	0.8	3.3	1.68	3.01
SESCO	148	437	585	3.0	0.6	1.5	1.20	1.65
TARRANT	140	410	550	2.9	0.9	1.7	1.20	1.65
UNITED (KY.)	122	718	840	5.9	1.0	2.6	1.9	2.50
VAN TRAN	122	592	714	4.9	1.0	2.1	1.6	2.05
WESTINGHOUSE	105	775	880	7.4	1.0	3.3	2.1	3.2

50 kVA

7200 Volts
7620 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit -ation I%	Imped -ance %Z	% Regulation 1.00PF	.80PF
DOWZER	183	572	755	3.1	1.0	1.9	1.14	1.82
G.E.	145	400	545	2.8	0.7	1.8	0.81	1.64
HOWARD	174	730	904	4.2	1.4	2.3	1.45	2.23
KUHLMAN	156	818	974	5.2	0.9	2.5	1.65	2.44
McGRAW	192	588	780	3.1	1.0	1.6	1.18	1.59
NECO	180	635	815	3.6	1.2	2.0	1.2	2.0
RTE	167	725	892	4.4	0.7	2.7	1.51	2.58
SESCO	185	550	735	3.0	0.6	1.6	1.14	1.48
TARRANT	174	534	708	3.1	0.8	1.8	1.15	1.60
UNITED (KY.)	176	646	822	3.7	1.3	2.1	1.32	2.04
VAN TRAN	141	783	924	5.5	1.0	2.2	1.6	2.2
WESTINGHOUSE	130	850	980	6.5	1.0	2.6	1.7	2.5

5 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit -ation I%	Imped -ance %Z	% Regulation 1.00PF	.80PF
HOWARD	40	111	151	2.8	2.4	2.3	2.18	2.25
KUHLMAN	46	111	157	2.4	1.5	2.5	2.23	2.47
SESCO	56	93	149	1.7	2.2	2.0	1.88	2.03

10 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit -ation I%	Imped -ance %Z	% Regulation 1.00PF	.80PF
CENTRAL MOLONEY	61	191	252	3.1	2.2	2.2	1.92	2.19
DOWZER	64	166	230	2.6	1.5	1.8	1.66	1.74
ERMCO	65	163	228	2.5	2.03	1.8	1.63	1.60
G.E.	43	260	303	6.0	0.9	2.8	2.60	2.66
HOWARD	47	261	308	5.6	2.4	3.1	2.57	3.05
KUHLMAN	46	266	312	5.8	1.0	2.9	2.67	2.82
McGRAW	62	170	232	2.7	1.1	2.0	1.71	1.99
NECO	42	249	291	6.5	1.0	3.0	2.4	2.9
PORTER	55	159	214	2.9	0.8	3.2	2.17	3.17
RTE	45	297	342	6.6	3.7	0.8	3.04	3.70
SESCO	68	148	216	2.2	1.6	1.7	1.5	1.75
UNITED (KY.)	38	257	295	6.7	1.0	3.0	2.5	3.0
VAN TRAN	90	128	218	1.4	1.3	2.7	2.35	2.65
WESTINGHOUSE	51	234	285	4.5	1.2	2.8	2.3	2.7

15 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Losses-Watts Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	% Regulation .80PF
CENTRAL MOLONEY	90	216	306	2.4	1.9	1.8	1.45	1.80
DOWZER	85	256	341	3.0	1.3	2.0	1.70	1.98
ERMCO	80	225	305	2.7	1.7	1.7	1.50	1.80
G.E.	47	373	420	7.9	0.8	3.2	2.51	3.19
HOWARD	59	388	447	6.6	2.1	3.2	2.56	3.23
KUHLMAN	54	391	445	7.2	0.9	3.2	2.62	3.20
MAGNETIC	85	240	325	2.7	1.8	1.8	1.6	1.78
McGRAW	85	189	274	2.2	1.0	1.6	1.26	1.6
NECO	54	319	373	6.0	1.0	2.8	2.1	2.7
PORTER	72	237	309	3.3	0.7	2.8	2.08	2.78
RTE	77	240	317	3.1	1.2	2.0	1.61	1.97
SESCO	82	212	294	2.6	1.1	1.7	1.35	1.75
UNITED (KY.)	54	331	385	6.1	1.0	2.8	2.2	2.8
VAN TRAN	88	213	301	2.4	1.0	1.7	1.45	1.7
WESTINGHOUSE	55	377	432	6.8	1.0	3.4	2.5	3.3

25 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	.80PF
CENTRAL MOLONEY	113	327	440	2.9	1.2	1.9	1.32	1.88
DOWZER	115	335	450	2.9	1.0	1.9	1.34	1.88
ERMCO	116	308	424	2.6	1.5	1.6	1.23	1.60
G.E.	69	483	552	7.0	0.7	3.1	1.96	3.00
HOWARD	86	572	658	6.7	1.6	3.0	2.26	2.98
KUHLMAN	89	515	604	5.8	0.9	3.1	2.09	3.04
MAGNETIC	110	440	550	4.0	2.0	2.2	1.8	2.2
McGRAW	130	289	419	2.2	1.0	1.6	1.16	1.59
NECO	81	460	541	6.5	1.0	3.3	2.0	3.0
PORTER	110	375	485	3.4	0.7	2.5	1.95	2.47
RTE	103	390	493	3.8	1.0	2.2	1.55	2.15
SESCO	116	340	456	2.9	1.0	2.1	1.4	2.1
UNITED (KY.)	76	489	565	6.4	1.0	3.2	1.9	3.1
VAN TRAN	121	381	502	3.2	0.7	2.1	1.55	2.1
WESTINGHOUSE	89	526	615	5.9	1.0	3.3	2.1	3.2

37 1/2 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	.80PF
DOWZER	160	480	640	3.0	1.0	1.9	1.28	1.86
ERMCO	157	490	647	3.1	1.51	1.9	1.31	1.87
G.E.	117	364	481	3.1	0.7	1.9	0.98	1.70
HOWARD	137	624	761	4.6	1.7	2.9	1.66	2.74
KUHLMAN	109	709	818	6.5	0.8	3.1	1.92	2.99
McGRAW	168	416	584	2.5	1.0	1.6	1.12	1.58
NECO	120	730	850	6.0	1.0	2.6	1.8	2.5
RTE	149	539	688	3.6	1.1	2.1	1.45	2.09
SESCO	154	453	607	3.0	1.0	1.9	1.35	1.90
UNITED (KY.)	122	718	840	5.9	1.0	2.5	1.8	2.5
VAN TRAN	151	516	667	3.4	0.6	2.2	1.40	2.10
WESTINGHOUSE	105	760	865	7.2	1.0	3.2	2.1	3.1

50 kVA

14400 Volts

Manufacturer	Losses-Watts Fe	Cu	Total	Cu/Fe Ratio	Excit-ation I%	Imped-ance %Z	% Regulation 1.00PF	.80 PF
DOWZER	195	565	760	2.9	1.0	1.7	1.13	1.66
ERMCO	184	657	841	3.6	1.5	2.0	1.31	1.96
G.E.	145	419	564	2.9	0.7	1.9	0.85	1.70
HOWARD	182	683	865	3.8	1.4	2.8	1.37	2.52
KUHLMAN	156	799	955	5.1	0.9	2.6	1.62	2.51
McGRAW	198	485	683	2.5	1.0	1.8	0.98	1.69
NECO	179	640	819	3.7	1.1	2.2	1.3	2.1
RTE	183	639	822	3.5	0.8	2.0	1.25	1.93
SESCO	193	555	748	2.9	0.9	1.6	1.13	1.50
UNITED (KY.)	175	644	819	3.7	1.1	2.2	1.34	2.09
VAN TRAN	190	640	830	3.4	0.6	1.7	1.30	1.75
WESTINGHOUSE	130	820	950	6.3	1.0	2.6	1.6	2.5